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ABSTRACT

To further understanding of the vocational development process, this study examined the relationship among various measures of in-school success and investigated their relationship to selected student characteristic variables. The sample consisted of 109 vocational students for the 10th grade phase and 105 of the same students for the 11th grade phase. The dependent variables (measures of success) were grade point average (GPA) for Grades 10 and 11, shop grades for Grades 10 and 11, and Ohio Trade and Industrial Achievement Test (OTAT) raw scores, while independent variables consisted of: (1) ability as measured by selected scales of the General Aptitude Test Battery (GATB), (2) occupational values as measured by four scales of the Occupational Values Inventory (OVI), and (3) vocational maturity as measured by the Vocational Development Inventory (VDI). Analysis by means of Pearson product moment correlations and multiple regression analysis yielded these findings: (1) Grade 11 GPA was found to be most predictable and OTAT least predictable of school success, (2) Verbal aptitude, numerical aptitude, vocational maturity, and value of salary seem to be the most useful of student characteristics used in predicting the measures of success, and (3) Grade 10 shop grade is the only success measure in which manipulative abilities are important predictors. Implications are discussed. (SB)

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THE PENNSYLVANIA STATE UNIVERSITY
DEPARTMENT OF VOCATIONAL EDUCATION

EVALUATION OF IN-SCHOOL SUCCESS CRITERIA FOR VOCATIONAL-TECHNICAL STUDENTS.

PATRICK A. O'REILLY

Pennsylvania Department of Education
Bureau of Vocational, Technical and Continuing Education
Research Coordinating Unit
(Project No. 19-1031)

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VOCATIONAL DEVELOPMENT STUDY SERIES

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Evaluation of In-School Success Criteria for Vocational-Technical Students

Patrick A. O'Reilly

The Pennsylvania State University

University Park, Pennsylvania

May, 1972

Pennsylvania Department of Education
Bureau of Vocational, Technical and Continuing Education
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PREFACE

As the sixth monograph in the Vocational Development Study (VDS) series, this study is one of a continuing research effort being undertaken in the Department of Vocational Education to develop a greater understanding of the vocational development process.

In a number of previous VDS research efforts, it was necessary to utilize a measure of in-school success and for different purposes various measures were selected. In this report, O'Reilly has attempted to examine the relationship among the various measures of in-school success commonly used and to investigate their relationship to selected student characteristic variables. He has also proposed a model which ties together the various success measures and which is supported by the results of this study. Although the relationship between in-school success and success in life was not examined in this study, future VDS studies will attempt to explore this aspect of the model further.

During the completion of this monograph, the VDS project staff and the Department of Vocational Education experienced the tragic loss of its leadership when Dr. Joseph T. Impellitteri was killed in an automobile accident enroute to a career education conference at Ohio State University. It is hoped that this VDS monograph and those which will follow will continue in the direction which he had intended.

Jerome T. Kapes, Assistant Professor
Graduate Studies and Research
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VDS CAPSULE OF FINDINGS AND IMPLICATIONS

This section is intended to provide a brief but thorough summary of this study which will be of practical value to teachers, counselors, administrators, and other school personnel. It is hoped that ninth grade counselors and those persons associated with vocational programs will find it to contain practical and useful information. In light of the objectives of this section, the following discussion will be as brief as possible.

Findings

1. This study attempted to predict in-school success criteria using sixteen student characteristics. Of the five criteria of success investigated in the study, GPA (11th Grade) was found to be most predictable and OTAT was found to be least predictable. The other success criteria in terms of predictability were: Shop Grade (11th Grade) second, GPA (10th Grade) third, and Shop Grade (10th Grade) fourth.
2. Excepting Shop Grade (10th Grade), all of the various success measures were found to be related. However, this relationship gets weaker as the time span between the measures increases.
3. Ninth grade student characteristics become more predictive with time. That is, they predict GPA (11th Grade) better than GPA (10th Grade).
4. Verbal aptitude, numerical aptitude, vocational maturity and value of salary seem to be the most useful of the student characteristics used in predicting all five measures of success.

5. Shop Grade (10th Grade) is the only success measure in which manipulative abilities are important predictors.

Implications

1. Verbal and numerical aptitudes play an important role in achievement within the vocational curriculum. It should be remembered, however, that they are not so important as to exclude other variables such as attitudes and values. The results of this study merely serve to re-emphasize that the student who is below average in terms of communications and computation skills will have difficulty in achieving no matter what curriculum he is enrolled in.
2. Because of the relationship among the success criteria, a student who is successful in terms of specific shop experience is likely to be successful in the overall educational system. However, a specific type of success is still best measured in terms of a given criteria. For example, GPA best measures success in the overall educational system while shop grade best measures success in a specific vocational course. This is, of course, what would have been expected.
3. Maniuplative abilities seem to be important in determining success in tenth grade shop. In eleventh grade, these abilities are less important. This may indicate that by the eleventh year, students have become more uniform in terms of manipulative ability. As the student progresses to the eleventh year shop, cognitive skills, attitudes,

and values seem to become more important in determining student achievement.

4. Vocational maturity and value of salary are quite important in determing success in the overall educational program. That is, the student who sees the relationship between all of his educational endeavors and his occupational goals, and who is capable of delaying gratification in terms of salary will more likely achieve better in terms of both GPA and Shop Grades. This finding offers a very real challenge for educators to show vocational students the relationship and value of all of their educational experiences to the attainment of future occupational gratifications.

I

ORIGIN AND IMPORTANCE OF THE STUDY

Introduction

Some form of occupational education has taken place since the beginning of time. This educational process has progressed from the informal father-son and apprenticeship relationships to more formal teacher-student relationships. Within the United States, the beginning of formal occupational education can be traced to the sloyd and manual training movements of the late 1800's and early 1900's. The influx of federal funds with its need for accountability began in 1917 with the Smith-Hughes Act which allocated approximately seven million dollars for vocational education. Since 1917 the amount of money allocated for vocational education at the federal level has increased to approximately 446 million dollars in 1971 (Burkett, 1971). The objectives of vocational instruction have changed from merely teaching the skills necessary to survive to providing those technical and specialized skills, knowledges and attitudes which will enable the student to earn a comfortable living.

Along with the development of an educational system, a system to measure the student's success in mastering the instruction has also been developed. This latter system is based on the assumption that a student's success in later life is related to his mastery of the instruction. The student's mastery of instruction is also predictable to some degree by personal characteristics. In early times the ability to provide the family unit with food in the form of wild game may have been a measure of success in life. The ability to shoot an arrow straight may have been a measure of success in mastering instruction, and predictors of this

success may have been physical strength, steadiness of nerves and keenness of eyesight. Modern day measures of success in life might be affluence, position in the community or occupation. In terms of educational success, modern day measures that are often used are grade point average (GPA), particular class grades and standardized test scores. Predictors of these measures of success in school are abilities and other personal characteristics. The degree to which a student displays these characteristics is predictive of his educational success.

Increasing money for vocational education has brought ever increasing need for justification and evaluation, and has led to the need to develop appropriate measures of success for both product and process. (One of the basic assumptions about educational success is that the degree of educational success is indicative of the degree of success in life upon completion of the educational process). These measures of success may be either subjective or objective in nature thus influencing the reliability of their results as predictors of success in other situations. The development of objective instruments for measuring skills and knowledge taught by vocational education is at a relatively early stage when compared with the more academic areas of education as a whole.

Standardized achievement tests are usually designed to measure knowledge or performance. The first standardized tests were developed to test for knowledge acquired and were of the pencil and paper variety. Measures of performance have been developed more recently and are generally of two types, competency measures of cognitive skill and "hands on" type of observation which attempt to measure manipulative skill. Problems have been encountered in standardization due to the fact that

performance measures must be administered to either small groups or single individuals at a time. This makes it very difficult to hold all factors constant. By contrast, most knowledge measures may be administered to a large group of subjects quite readily.

A recent development in objective types of instruments for vocational education is the Ohio Trade and Industrial Education Achievement Test (OTAT). Finch and Bjorkquist (1970, p. 38) state:

> "In recent years, standardized achievement tests have been developed which show great promise in the measurement of learning outcomes (Ohio Trade and Industrial Education Services, 1970; Baldwin, 1969). These measures have been painstakingly developed and report high test and subtest reliabilities."

Because the subjective measures of success have been used for a longer period of time, they have tended to become the criterion against which the newer objective measures are judged. Long and Kapes (1970) conducted a study to determine the relationship between OTAT total test scores and end-of-course shop grades. They report that the OTAT may validly measure knowledge of course content but that this is only a small portion of what instructors use to determine grades. Likewise, for vocational students, success in terms of shop grade is only a part of the measure of success in the total educational process. Traditionally, total educational success has been measured in terms of overall performance, usually interpreted as total grade point average (GPA). The relationship of these three measures of success as well as their relationship to success in life is visibly depicted in Figure 1.

From Figure 1, it is shown that "success in life" is dependent upon success in many areas of life. One of these areas is educational success. Educational success is made up of success in many areas. An index of

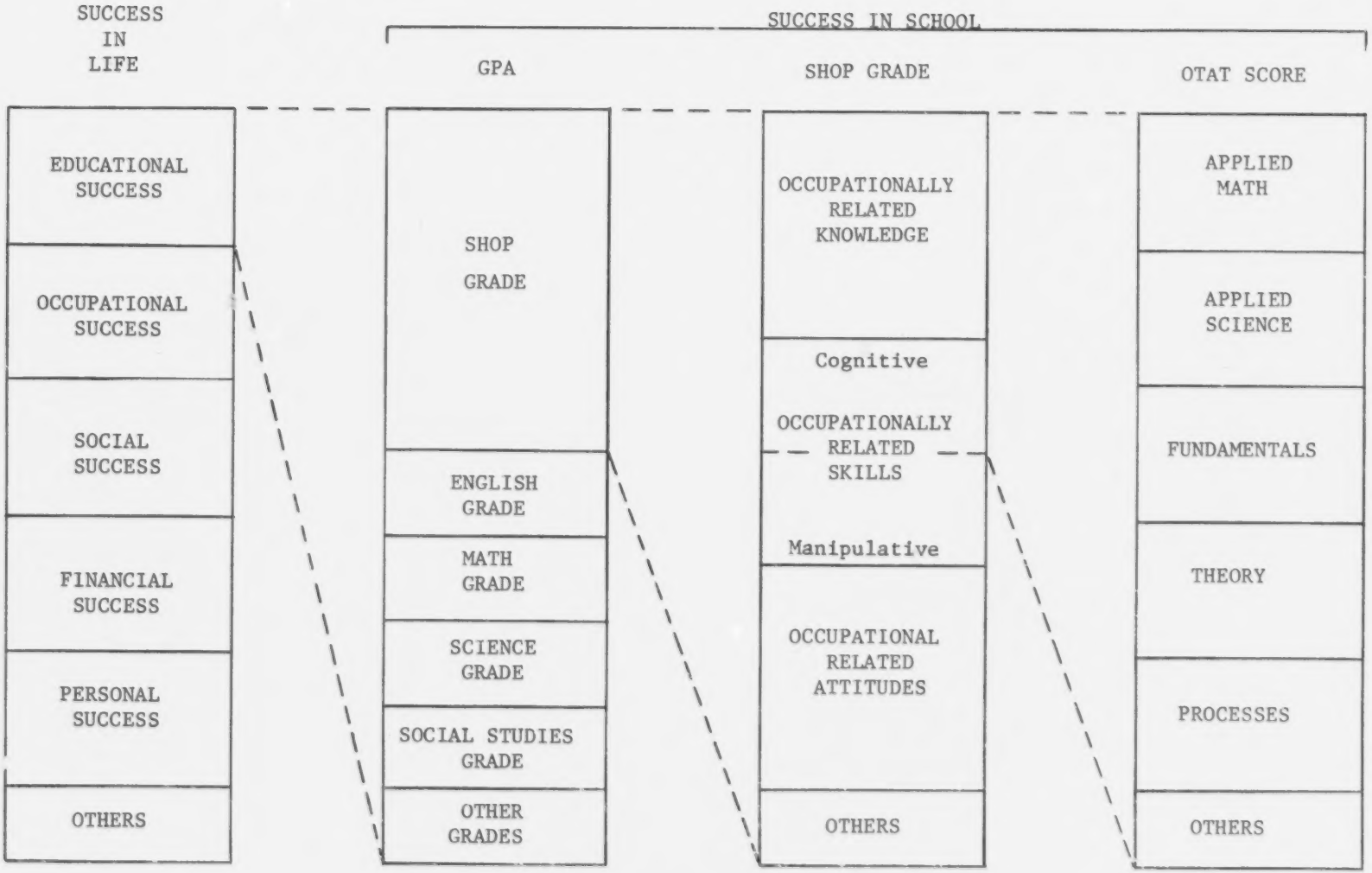

FIGURE 1. Relationship Among Success Measures

educational success is GPA. GPA is a cumulative average which reflects how much the student learned in all of his in-school activities. Because the vocational student spends approximately fifty percent of his time in the vocational shop, shop grades would make up fifty percent of the "in-school" success. Shop grade is based on the instructor's evaluation of the student's performance with regard to knowledge, cognitive and manipulative skills, attitudes, and other factors which he may consciously or unconsciously deem important. Standardized "pencil and paper" tests such as the OTAT measure knowledge and cognitive skills and as previously discussed, these represent only a part of the entire shop grade. Because GPA, shop grade, and OTAT score are criteria of success; and given that they measure different aspects of success as conveyed by Figure 1, it becomes necessary to examine the degree of relationship among them.

Cooley and Lohnes (1968) developed a career theory based on a career tree concept. The career tree depicts paths which may be chosen during the career development process. The path which is chosen is determined by decisions made at points in time with reference to education, interests, aptitudes, etc. Kapes (1971) as reported in VDS Monograph Number 2, found that success was an important concept in the development of a career tree. Thus, it is important to determine the relative merits of the various school success measures now in use. Since, in fact, more than one type of school success does exist, it becomes very important to know how the various measures of success are related to each other and to various predictors of success. The greater the relationship among the criteria, the less critical the decision of choosing a criterion with which to measure the student's success.

If, in fact, the criteria are different, it then becomes important to determine what ninth grade characteristics are important in predicting success in terms of the different criteria. This information will be quite useful to counselors in encouraging students to capitalize on their strong characteristics and strengthen those that are weak. It will help the counselor to show the student where he is likely to succeed and where he is likely to encounter difficulty. Another important outcome of determining the predictors of each of the criteria is the determination of whether or not they measure what they are supposed to measure. That is, does the OTAT measure knowledge and cognitive skill, the shop grade specific occupationally related skills, knowledge, and attitudes, and GPA a broad variety of skills, knowledge and attitudes. For example, the OTAT should be predicted by cognitive aptitudes, shop grade by a combination of abilities and certain personality characteristics and GPA by a broad range of abilities, personality characteristics and background measures.

Statement of the Problem

In order to attempt to explain and discover patterns of vocational development in secondary students, a longitudinal research effort was begun at The Pennsylvania State University in 1968. It is in support of and in conjunction with this continuing effort that this particular study was initiated. In attempting to predict success as measured by GPA, Kapes (1971) utilized sixteen selected ability, achievement, and socio-economic variables. Enderlein (1972) investigated the relationship between success as measured by total OTAT score and selected ability measures as well as choice of trade area in terms of whether or not the

student was assigned to the trade area which was his first choice. The same student characteristic variables which were used in these two previous studies were also used in this study except for choice of trade area used in the Enderlein study.

For the purposes of this study, the following student characteristics were selected for use based on the two studies previously cited: General Aptitude Test Battery (GATB) scales V, N, S, P, Q, K, F and M. Occupational Value Inventory (OVI) scales, Interest and Satisfaction, Salary, Prestige, Security, Vocational Maturity as measured by the Vocational Development Inventory (VDI), Father's Educational and Occupational Level, and the student's Level of Occupational Aspiration. The five criteria which were chosen follow directly from the model shown in Figure 1. These are tenth and eleventh year grade point average (GPA), tenth and eleventh year shop grade, and total OTAT raw score at eleventh year.

In an effort to further explore the use of GPA, shop grade, and OTAT total raw score as success measures, the following questions were answered:

1. What is the relationship among the five measures of school success?
2. Which combination of ninth grade student characteristics most efficiently predict school success as measured by tenth year GPA?
3. Which combination of ninth grade student characteristics most efficiently predict school success as measured by tenth year shop grades?
4. Which combination of ninth grade student characteristics most efficiently predict school success as measured by eleventh year GPA?

5. Which combination of ninth grade student characteristics most efficiently predict school success as measured by eleventh year shop grades?
6. Which combination of ninth grade student characteristics most efficiently predict school success as measured by eleventh year OTAT scores?

II

REVIEW OF RELATED LITERATURE

Introduction

In an effort to identify other studies and articles which contain information pertinent to this study a review of the literature was undertaken. The literature was grouped into the following categories:

1. Studies and publications concerning the student characteristic variables used in this study.
2. Studies and publications concerning the various measures of success used in this study.
3. Studies and publications relating to and/or supporting the methodology and techniques used in this study.
4. Studies and publications concerning the relationship between in-school and out-of-school success.

Because of the relationship between this study and previous studies, specifically Kapes (1971) VDS Monograph Number 2, entitled The Relationship Between Selected Characteristics of Ninth Grade Boys and Curriculum Selection and Success in Tenth Grade and Enderlein (1972) VDS Monograph Number 4, entitled An Examination of the Relationship of Selected Student Variables to Vocational-Technical Shop Achievement, an extensive discussion of the first three categories will not be conducted in this study. Rather, reference will be made to the previous studies. Only the fourth category and recent studies pertinent to the first three categories which were not previously discussed will be treated at any length.

Studies and Publications Concerning the Student Characteristic Variables Used in This Study

The following literature has been extensively discussed by Kapes (1971) in VDS Monograph Number 2. Should any particular study be of

further interest, reference should be made to the previously mentioned study. The following summary is taken from Kapes (1971) VDS Monograph Number 2. pp. 56-58.

Summary

1. As a multiple ability measure, the GATB appears to be very complete and extremely useful for studies related to adolescent career decision making and school achievement in both the academic and vocational-technical areas (Droge, 1965, 1966; Impellitteri and Kapes, 1969; Ingersol and Peters, 1966; Kapes, 1969a, 1969b; Pickett, 1958; Samuelson, 1956; Super and Crites, 1962; U. S. Department of Labor, 1967).
2. Occupational values as a career development construct is receiving increasing attention and appears to possess valid and useful relationships to many of the student behaviors of interest in career development research (Dipboye and Anderson, 1959; Gribbons and Lohnes, 1965; Kapes, 1969; Kinnane and Pable, 1962; Singer and Stefflre, 1954; Sprinthall, 1966; Super, 1962; Thompson, 1966; and Zytowski, 1970).
3. A strong argument can be made for the essentially ipsative nature of occupational values (Beck and Barek, 1967; Impellitteri and Kapes, 1970; Kapes, 1969; Katz, 1963; and Zytowski, 1970).
4. The VDI appears to be one of several possible valid measures of the construct of vocational maturity, and

has been shown to be related to intelligence, age, grade, sex, curriculum, choice and socioeconomic status (Asbury, 1968; Bathory, 1967; Crites, 1965, 1969; Crites and Samler, 1967; Dutt, 1968; Gribbons and Lohnes, 1968; Holloway, 1967; Impellitteri, et al., 1969; Pucel, et al., 1970, 1971).

5. The two variables, father's educational and occupational level, appear to contain enough information to be representative of a student's socioeconomic background (Blau and Duncan, 1967; Hollingshead, 1949; Reiss, et al., 1961; Super and Overstreet, 1960; Warner, 1949).
6. A student's socioeconomic level has been shown to be related to his intelligence, vocational aspirations, curriculum choice, school participation, school grades, and overall achievement as well as to other measurable characteristics (Bachman, 1970; Blau and Duncan, 1967; Clark, 1967; Gribbons and Lohnes, 1966, 1968; Hollingshead, 1949; Krippner, 1963; Super and Overstreet, 1960; Weinberg and Skager, 1966).
7. An individual's level of occupational aspiration has been shown to be both a predictor and a resultant of his interaction with his environment, and is stable enough at the ninth grade level to be useful in developmental research (Asbury, 1968; Bachman, 1970; Bathory, 1967; Clark, 1967; Flanagan, 1966; Gribbons and Lohnes, 1966, 1968; Krippner, 1963; Miller and Haller, 1964; Montesano and Geist, 1964; Super

Overstreet, 1960; Thomas, 1965; Whitney, 1969).

Studies and Publications Concerning the Various Measures of Success Used in This Study

Enderlein (1972) found the OTAT to be a useful instrument in evaluating cognitive skills and knowledge in terms of a vocational program, however, it was not found to be useful in assessing manipulative skills. The studies listed under 1 and 2 in the summary have been reviewed at length by Enderlein (1972) in VDS Monograph Number 4, and will not be reviewed here. Further information about these studies can be obtained by referring to VDS Monograph Number 4.

The following literature relates to the use of GPA or Shop Grade as a criterion of success. Since they have not been reviewed in either VDS Monograph Number 2 or Number 4, they will be reviewed here.

Finger (1966) in an article Academic Motivation and Youth-Culture Involvement: Their Relationships to School Performance and Career Success used GPA as an indicator of school achievement. GPA was then related to persistence and choice of occupational area. In both cases, the relationship was found to be significant.

Hoyt (1966) conducted a review of research entitled College Grades and Adult Accomplishment. It was concluded that GPA or a specific course grade may not be a completely valid measure of in-school achievement; however, they are usually the only assessments made. Therefore, until modifications are made in the process of grade assignment, they are the only assessments available at this time.

A comprehensive review of research dealing with success was undertaken by Calhoon and Reddy (1968). Fifteen studies were found which utilized grades as in-school success criteria. Over half of these studies

seemed to show some connection between grades a. ability.

Kapes and Long (1971) concluded that shop grades include many factors, other than ability or knowledge, which had not been identified. Additionally, the OTAT is useful in assessing knowledge of course content; but measures only a small portion of those factors considered by shop instructors in assigning grades.

Kapes (1971) found GPA to be a useful criterion in distinguishing between successful and unsuccessful male students. GPA, therefore, appears to be a valid measure of overall in-school success.

Enderlein (1972) was unable to determine if end-of-course shop grade was a valid measure of achievement. However, as previously discussed, the OTAT was determined to be useful and shop grades were found to correlate significantly with OTAT scores.

Summary

1. The OTAT is a useful instrument relative to evaluation of learning outcomes (Baldwin, 1969; Finch and Bjorkquist, 1970; Kapes and Long, 1971; Enderlein, 1972).
2. Caution should be used in certain applications of the OTAT (Finch and Bjorkquist, 1970; Kapes and Long, 1971; Moss and Stromsdorfer, 1970).
3. Grades, both GPA and for specific courses, seem to have value as indicators of in-school success. (Finger, 1966; Hoyt, 1966; Calhoon and Reddy, 1968; Kapes, 1971; Enderlein, 1972).

Studies and Publications Relating to and/or Supporting the Methodology Used in This Study

Kapes (1971) utilized a multiple regression analysis (MRA) in his study published as VDS Monograph Number 2. A step-down technique was also found useful in computing restricted models. The following studies were reviewed extensively by Kapes in VDS Monograph Number 2 and, therefore, will be only listed here. Further information can be found by referring to the Kapes study.

Summary

1. Multiple regression analysis appears to be a useful statistical technique for use in the behavioral sciences (Totsouka, 1957; Kaufman, et al., 1967; Rulon, 1967; Cooley and Lohnes, 1968; Moss, 1968; Super 1969b; Sonquist, 1970; Hu, Lee and Stromsdorfer, 1971; Kapes, 1971; Wallberg, 1971).

Studies and Publications Concerning the Relationship Between In-School and Out-of-School Success

One of the biggest problems in studies of success is the definition of success. What is success? Super (1951a) said:

> "Success," as the world judges it, is fruitless and empty unless it is also seen as success by the individual. What would wealth have been to Ghandi, or the love and respect of humble men and women to Bismark? What use had Thoreau for prestige and status, or Theodore Roosevelt for opportunities to be alone with himself and the universe? In the eyes of each of these persons, and of some others, each of them was successful; but in the judgment of many, each of them was a failure. Individual values and hence individual judgments, differ in such matters.

Success is extremely hard to define and any particular definition will probably not be accepted by all individuals.

Crites (1969) devotes considerable energy to exploring the different criteria which have been defined as vocational success. Some of the criteria that have been used in the past include quality of work, quantity of work, advancement, self or supervisor ratings, and earnings. Crites concludes by suggesting that a good success criterion would combine many of those criteria previously used. This would create a criterion which would be more universely acceptable. It would also have the effect of making success research more difficult. The following studies should be considered while keeping the specific criterion used in mind.

Finger (1966) studied the success of 1947-1952 graduates of Brown University. It was found that the degree of in-school success had an effect upon career choice. Careers were defined as either business or professional types. It was also found that once the type of career was chosen, in-school success was related to out-of-school success. The criteria for success in business type careers were income and position. For professional type careers, the criteria were type of position and/or income.

Calhoon and Reddy (1968) compiled a review of fifteen studies of the relationship between in-school success and out-of-school success. Salary was used alone in eleven of the studies as the success criterion. The remaining studies used supervisor ratings, performance appraisals, and various combinations of variables as the success criterion. Of the fifteen studies reviewed, eight found at least a slight correlation between in-school and out-of-school success. Several factors which may have contributed to findings of no significant correlations were: (1) indications

that non-respondents tended to be below average in grades and salary, and (2) the fact that business careers were combined with low-pay professions. There are indications that a considerable number of highly successful students chose low-pay professional careers. Thus, salary alone is not a completely valid success criterion. The many problems in defining success are again discussed in the Calhoon and Reddy article.

Coppedge (1969) investigated the relationship between several in-school measures of success and occupational success. Occupational success was determined by salary and ratings made on each employee by the employer. The relationship was not found to be significant at the .05 level. However, the follow-up was conducted only four years after high school graduation.

Cox (1971) defined a vocationally successful person as one who was working in a training-related job five years after graduation from a trade-technical or business school; was satisfied with his present job; felt the work was appropriate for him; had received an increase in wages, and had exhibited job stability. No significant relationship was found between this definition of occupational success and in-school success. This author repeats the problems involved in defining success.

Summary

1. Success is extremely difficult to define and the definition may effect study results (Super, 1951a; Crites, 1961; Calhoon and Reddy, 1968; Cox, 1971).
2. There appears to be some relationship between in-school success and out-of-school success (Finger, 1966; Calhoon and Reddy, 1968).

3. Expected relationships between in-school and out-of-school success were not found in some studies reviewed (Calhoon and Reddy, 1968; Coppedge, 1969; Cox, 1971).

III

PROCEDURES

Population and Sample

The hypothetical parent population to which the results of this study may be generalized would consist of what might be called average American high school students enrolled in those vocational shops for which Ohio Trade and Industrial Achievement Test (OTAT) is available. Because of the difficulty involved in describing an average American student, caution should be used when making generalizations and applications to students outside the actual parent population. To be included in the sample, subjects must have enrolled in a vocational program for which the OTAT was available and have taken the OTAT. These subjects must also have remained in school and in the same program at least through their eleventh grade year. The vocational programs for which the OTAT was available were: Auto Mechanics, Electricity, Electronics, Machine Shop, Drafting and Design, Printing, Sheet Metal, Welding, Auto Body, Carpentry, and Cosmetology.

The sample contained 109 male and female students for the tenth grade phase. For the eleventh grade phase, 105 of the original 109 students were retained. Three of the four who were not retained were males who dropped out of school. The only other subject not retained was a female who discontinued the vocational program. This sample contains part of the sample used by Kapes (1971) in a study of The Relationship Between Selected Characteristics of Ninth Grade Boys and Curriculum Selection and Success in Tenth Grade (VDS Monograph, Number 2). In an effort to minimize redundancy, background material which is common

to both samples will not be repeated. Only those characteristics which are unique to the sample used in this study will be discussed. All data for this study was collected as part of a continuing longitudinal study of vocational development being conducted by the Department of Vocational Education at The Pennsylvania State University in cooperation with the Pennsylvania Research Coordinating Unit.

Essential Data

Independent Variables. Those student characteristics which were used as predictor or independent variables in this study correspond directly with those utilized by Kapes (1971). Therefore, the rationale for their use will not be repeated and only a brief description of each will be included.

Eight of the nine General Aptitude Test Battery (GATB) aptitude scores were used as ability measures. They were:

V - Verbal Aptitude--The ability to understand meanings of words and to use them effectively. The ability to comprehend language, to understand relationships between words and to understand meanings of whole sentences and paragraphs.

N - Numerical Aptitude--Ability to perform arithmetic operations quickly and accurately.

S - Spatial Aptitude--Ability to think visually of geometric forms and to comprehend the two-dimensional representation of three-dimensional objects. The ability to recognize the relationships resulting from the movement of objects in space.

P - Form Perception--Ability to perceive pertinent detail in objects or in pictorial or graphic material. Ability to make visual comparisons and discriminations and see differences in shapes and shading of figures and widths and lengths of lines.

Q - Clerical Perception--Ability to perceive pertinent detail in verbal and tabular material. Ability to observe differences in copy, to proof read words and

numbers, and to avoid perceptual errors in arithmetic computation.

K - Motor Coordination--Ability to coordinate eyes and hands or fingers rapidly and accurately in making precise movements with speed. Ability to make a movement response accurately and swiftly.

F - Finger Dexterity--Ability to move the fingers, and manipulate small objects with the fingers, rapidly and accurately.

M - Manual Dexterity--Ability to move the hands easily and skillfully. Ability to work with the hands in placing and turning motions.

In order to obtain information on occupational values, the Occupational Values Inventory (OVI) was used. Although the OVI measures seven occupational values, only four were used in this study. These four are:

1 - Interest and Satisfaction--One likes the work, enjoys it, is happy at it, fulfills oneself by doing it.

2 - Salary--One perceives the financial return resulting from the work, can make a good living at it, sees it as an opportunity for a good income.

3 - Prestige--One is impressed by the respectability attached to the work, can earn recognition from it, desires the feeling of importance that goes with it.

4 - Security--One can obtain employment in this work, perceives that workers are needed in it, there will always be openings in it.

The Vocational Development Inventory (VDI) was administered and used as an indicator of vocational maturity. Vocational maturity as defined by Crites (1961):

> Refers to the maturity of an individual's vocational behavior as indicated by the similarity between his behavior and that of the oldest individuals in his vocational life stage.

Two family background indices were selected for use in an effort to account for socioeconomic background. The two variables were father's educational level and father's occupational level. Father's educational

level was coded from "1" being less than six years of formal education to "7" being education beyond the baccalaureate degree. Father's occupational level was coded according to Roe's (1956) classification scheme with "1" being the highest level (Professional and Managerial I) to "6" being the lowest level (Unskilled).

The final independent variable selected for use in this study was the student's occupational aspiration level. This was actually the level of the occupation to which the student realistically aspired according to Roe's (1956) classification scheme coded in the same manner as father's occupational level.

Dependent Variables. Three criterion variables were selected for use in this study. All three are commonly applied to measure success in a particular phase of education or in the total educational process. Of the three selected, two were collected at two points in time, these were grade point average (GPA) and shop grade. The remaining variable, OTAT total raw score, was collected at only one point in time. Thus, five criterion variables were used.

Success in the total educational process was measured by GPA. Kapes (1971) used GPA as a success measure in VDS Monograph, Number 2. For the purposes of this study, GPA was obtained at the end of both the tenth and eleventh grades. The GPA was computed by weighting the grade received in the vocational shop equally with the total of all major subject grades received in non-vocational subjects. Figure 2 shows the grading system used by the Altoona school system and some equivalents.

Altoona	Equivalents	
5	A	Excellent
4	B	Above Average
3	C	Average
2	D	Below Average
1	F	Failure

Figure 2: Altoona and Equivalent Grading Systems

Success in the vocational curriculum was measured in two ways. The first of these, shop grade, was also obtained at two points in time, namely end of tenth and end of eleventh grades. Enderlein (1972), (VDS Monograph, Number 4), utilized end of course shop grade as a measure of achievement in his study of vocational-technical shop achievement, (An Examination of the Relationship of Selected Student Variables to Vocational-Technical Shop Achievement).

It was assumed that an average grade in any two shops were equal indicators in terms of student success, thus, raw shop grades were used instead of standardized grades. This assumption was based on findings by Kapes (1969, p. 11).

> Depending on the grading system used in a school system and on the homogeneity of the grading practices, raw score grades may be as useful as converted grades as a criterion of training success.

The final criterion variable selected for use in this study was OTAT total raw score which is also a measure of success in the vocational curriculum. The OTAT is composed of sub-tests and the number of sub-tests varies with the shop area. In addition, no reliability information is available on the sub-tests, but reliability coefficients are reported for

the total test scores. For these reasons it was decided to standardize the total raw scores over the entire sample, these standard scores have a mean of 500 and a standard deviation of 100. The OTAT total raw scores were obtained in March of the eleventh grade year. Further information about the OTAT can be obtained by referring to Enderlein (1972) VDS Monograph, Number 4.

Analysis

In order to provide meaningful, clear answers to the questions proposed by this study, two statistical methods were employed. In answering question 1, Pearson Product Moment Correlations (PPMC) were used. The other five questions were answered by using multiple regression analysis (MRA).

In answering question 1, Pearson Product Moment Correlations were used to test the degree of relationship among the five criterion variables.

Dubois (1965, p. 157) offers the following comments on the interpretation of correlation coefficients:

> Although correlations vary from .00 to 1.00 (and negatively from .00 to -1.00), they cannot be considered as proportions (or percentages). Basically, an r is merely the slope of the best-fitting, least squares line, after the variance of the two variables have been equalized. Somewhat indirectly, r becomes a measure of relationship by indicating (when squared) the proportions of the variance in one variable predictable through knowledge of the values in the other.

The remaining five questions were answered using the following multiple regression model:

$$y = b_o + b_1 x_1 + b_2 x_2 + \ldots b_k x_k + e$$

where

y = criterion or dependent variable

$x_1, x_2 \ldots x_k$ = independent variable

$b_o, b_1, b_2 \ldots b_k$ = partial regression coefficients

e = error term

The specific equation used was:

$$y_i = b_o + b_1 x_1 + b_2 x_2 + \ldots b_{16} x_{16} + e$$

where

y_1 = Tenth grade GPA

y_2 = Tenth grade shop grade

y_3 = Eleventh grade GPA

y_4 = Eleventh grade shop grade

y_5 = OTAT total score

and

x_1 = GATB--Verbal Aptitude (V)

x_2 = GATB--Numerical Aptitude (N)

x_3 = GATB--Spatial Aptitude (S)

x_4 = GATB--Form Perception (P)

x_5 = GATB--Clerical Perception (Q)

x_6 = GATB--Motor Coordination (K)

x_7 = GATB--Finger Dexterity (F)

x_8 = GATB--Manual Dexterity (M)

x_9 = Occupational Value--Interest and Satisfaction

x_{10}= Occupational Value--Salary

x_{11}= Occupational Value--Prestige

x_{12}= Occupational Value--Security

x_{13}= Vocational Maturity

x_{14}= Father's Educational Level

x_{15}= Father's Occupational Level

x_{16}= Occupational Aspiration Level

The use of the multiple regression technique allows the unique contribution of each variable to be tested for significance while holding the effects of all other variables constant. A restricted model containing only those variables making a significant unique contribution to explaining the criterion variable was calculated using a step-down technique.

Kapes (1971) has outlined the specific assumptions and advantages of using this technique. Should these be of interest, reference should be made to VDS Monograph 2. The specific computer program used was Statistical Analysis of Single Equation Stochastic Models Using the Digital Computer written by Hallberg (1969). This program is available as QSASE at the Penn State Computation Center.

During the course of this study, an alpha level of .05 was used to test all obtained statistics.

IV

FINDINGS

Introduction

Conclusions about the results of this study will be discussed in Chapter 5. This chapter will attempt to present the data as it pertains to each question. Whenever possible, findings will be presented in tabular form, however, some discussion will be necessary in order to avoid any possible misunderstanding. Discussion will be held to a minimum and findings will be related to previous studies whenever possible.

In order to provide a common base from which to work, means and standard deviations for the sixteen student characteristic variables have been presented in Table 1. As can be seen when comparing these findings with those of Kapes (1971), the means and standard deviations are quite similar. The differences that occur can probably be attributed to the smaller, restricted sample used in this study. As pointed out by Kapes (1971), these means and standard deviations approximate those figures considered to be national norms for ninth graders.

It is also necessary to examine the intercorrelations among the sixteen student characteristic variables as this will improve insight into why some variables are more useful than others when combined in a Multiple Regression Analysis to predict the criteria. This information is presented in Table 2. Table 3 shows the degree of linear relationship between the five criterion variables and the sixteen student characteristic variables. The degree of linear relationship is indicated by the zero-order correlation coefficient. This information coupled with that in Table 2 should provide an intuitive feeling for which student char-

Table 1. Means and Standard Deviations for the Sixteen Student Characteristic Variables

Variables		N = 109	
No.	Name	$\overline{X}$	SD
1.	GATB--Verbal	90.32	8.83
2.	GATB--Numerical	92.41	11.04
3.	GATB--Spatial	100.56	14.85
4.	GATB--Form Perception	97.41	17.89
5.	GATB--Clerical Perception	98.72	11.41
6.	GATB--Motor Coordination	87.76	12.96
7.	GATB--Finger Dexterity	91.61	18.07
8.	GATB--Manual Dexterity	88.61	17.54
9.	Value--Interest and Satisfaction	17.99	4.65
10.	Value--Salary	14.51	6.31
11.	Value--Prestige	10.52	4.77
12.	Value--Security	12.77	4.94
13.	Vocational Maturity	34.80	4.57
14.	Father's Education	3.69	1.04
15.	Father's Occupation	4.44	.81
16.	Occupational Aspirations	3.37	.93

Table 2. Zero-Order Correlations Among the Sixteen Student Characteristic Variables

N = 109

Variables	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1. GATB--V	.37	.20	.25	.31	.24	.05	.02	.30	-.10	-.20	-.12	-.46	-.21	-.04	-.06
2. GATB--N		.25	.41	.44	.40	.26	.27	.06	-.05	-.17	-.05	.29	.10	.11	-.06
3. GATB--S			.23	.13	.05	.22	.31	.21	-.14	-.14	.13	.24	.02	-.10	-.15
4. GATB--P				.57	.46	.32	.36	.10	-.11	.12	-.04	.08	-.12	.08	-.15
5. GATB--Q					.40	.35	.34	.10	-.15	.05	-.03	.04	-.16	.05	-.12
6. GATB--K						.37	.40	.15	-.06	.00	-.10	-.10	-.16	.06	.06
7. GATB--F							.53	-.02	-.03	.04	-.11	-.05	.03	.08	.03
8. GATB--M								.00	-.08	-.01	.03	-.12	.02	.15	-.01
9. Interest and Satisfaction									-.53	-.31	-.05	.32	.01	-.12	.02
10. Salary										-.09	-.25	-.08	.01	-.12	-.12
11. Prestige											-.06	-.46	-.12	.08	.24
12. Security												-.07	.10	-.02	.01
13. Vocational Maturity													.06	-.21	-.10
14. Father's Education														-.30	-.02
15. Father's Occupation															.03
16. Occupational Aspirations															

$r \geq .195$ Significant at α .05

Table 3. Zero-Order Correlations Between the Sixteen Student Characteristic Variables and the Five Measures of School Success

(N = 105)

Variables No.	Name	Shop Grade (10th Grade)	GPA (10th Grade)	Shop Grade (11th Grade)	GPA (11th Grade)	OTAT
1.	GATB--V	.20*	.38*	.41*	.45*	.37*
2.	GATB--N	.17	.40*	.29*	.37*	.18
3.	GATB--S	.24*	.21*	.17	.21*	.25*
4.	GATB--P	-.05	.12	.11	.16	-.07
5.	GATB--Q	-.11	.26*	.20*	.30*	.07
6.	GATB--K	-.06	.14	.12	.21*	.02
7.	GATB--F	.01	.12	-.01	.13	.03
8.	GATB--M	.19	.19	.04	.10	.04
9.	Interest and Satisfaction	-.01	.24*	.32*	.36*	.21*
10.	Salary	.06	-.13	-.31*	-.32*	-.12
11.	Prestige	-.13	-.19	-.27*	-.26*	-.21*
12.	Security	.02	-.06	-.05	-.08	.05
13.	Vocational Maturity	.21*	.35*	.47*	.41*	.36*
14.	Father's Education	.00	-.04	-.06	-.04	-.07
15.	Father's Occupation	.08	.03	-.09	-.06	-.06
16.	Occupational Aspirations	-.13	.09	.01	.03	-.03

* Significant at .05

acteristic variables will be useful in predicting a specific measure of school success.

It might be helpful to include here a reminder before preceeding further in interpreting the correlations and partial regression coefficients presented in any of the tables. When interpreting the relationship or predictive worth of Father's Occupational Level and Level of Occupational Aspiration in light of any other variables, a negative correlation or partial regression coefficient will indicate a positive relationship. This is true because of the way these two variables were coded. Both were coded uisng Roe's (1956) classification scheme where "1" equaled the highest possible level and "6" equaled the lowest possible level. Thus, these variables are negatively coded. This will cause the sign to be the reverse of what it should be when examining them in the light of any of the other variables.

Finally, the tables presented in this study have been constructed to allow direct comparisons with those in VDS Monographs 2 and 4. Since many of the student characteristic variables and school success measures used in this study overlap with the two previously mentioned studies, such comparisons will often be of interest. With these preliminary findings and remarks in mind, those findings pertinent to each question proposed in Chapter 1 will now be presented.

Question #1

What is the relationship among the five measures of school success?

In order to determine the degree of relationship among the five measures of school success, it is necessary to refer to Table 4.

It should be remembered that both GPA and Shop Grade were obtained at two points in time, namely end of the tenth year and end of the eleventh year.

Table 4. The Relationship Among the Five Measures of School Success

(N = 105)

Variables	2	3	4	5
1. Shop Grade (10th Grade)	.67*	.10	.07	.16
2. GPA (10th Grade)		.45*	.52*	.29*
3. Shop Grade (11th Grade)			.84*	.40*
4. GPA (11th Grade)				.43*
5. OTAT				

* Significant at .05

As shown by Table 4, seven of the possible ten relationships among the five measures of school success are significant at the .05 level. The noteable exception is Shop Grade (10th Grade) which does not correlate significantly with any other school success measure except GPA (10th Grade).

It should be remembered that in the computation of GPA (10th Grade) and GPA (11th Grade) the respective Shop Grade was used at 50 percent of the input to GPA. Thus, GPA and its respective Shop Grade would be expected to correlate quite highly.

Question #2

What combination of ninth grade student characteristics most efficiently predict school success as measured by tenth year GPA?

By quickly reviewing Table 3, it can be seen that six student characteristic variables correlated significantly with GPA (10th Grade) at the .05 level. These were GATB-V, GATB-N, GATB-S, GATB-Q, OVI-Interest and Satisfaction and Vocational Maturity. The correlation coefficients obtained between GPA (10th Grade) and the ten remaining student characteristic variables were not found to be significant.

In an effort to answer question 2, a multiple regression analysis (MRA) technique was used. Table 5 shows the predictiveness of the criterion, GPA (10th Grade), using all sixteen student characteristic variables. The obtained overall F-ratio for the full model was 2.6936 and is significant at the .05 level. The full model predicts a significant portion of the variability of GPA (10th Grade). The multiple correlation (R) is not presented in the table, but was found to be .55.

The unadjusted coefficient of determination (R^2) also not shown in the table, is the multiple correlation squared and is equal to .32. The coefficient of determination adjusted for degrees of freedom ($\bar{R}^2$) was computed to be equal to .20. The difference between the unadjusted and adjusted coefficients of determination is due to adjustments made to account for shrinkage which might occur upon cross-validation. Therefore, using all sixteen student characteristic variables, 20 percent of the variability of GPA (10th Grade) can be explained.

From Table 5, it can readily be seen that GATB-N is the only variable having a student "t" significant at the .05 level, that is, a value equal to or exceeding 1.98. This is to say that GATB-N was the only student characteristic variable that was unique enough to predict a significant portion of GPA (10th Grade) when taken in combination with all of the other fifteen student characteristic variables. Table 5 of this study

Table 5. Regression Analysis Between the Sixteen Student Characteristic Variables in the Full Model and the Dependent Variable GPA - 10th Grade

(N = 109)

Variables No.	Name	Partial Regression Coefficient	Standard Error	Student "t"
1.	GATB--V	.0199	.0110	1.8036
2.	GATB--N	.0244	.0091	2.6916*
3.	GATB--S	.0013	.0061	.2117
4.	GATB--P	-.0090	.0059	1.5260
5.	GATB--Q	.0003	.0090	.0307
6.	GATB--K	-.0015	.0080	.1822
7.	GATB--F	.0015	.0053	.2855
8.	GATB--M	.0065	.0058	1.1241
9.	Interest and Satisfaction	.0262	.0238	1.0981
10.	Salary	-.0033	.0165	.2010
11.	Prestige	.0176	.0211	.8344
12.	Security	.0112	.0174	.6407
13.	Vocational Maturity	.0403	.0234	1.7207
14.	Father's Education	.0303	.0828	.3657
15.	Father's Occupation	.0374	.1047	.3572
16.	Occupational Aspiration	-.1021	.0893	1.1430
Intercept		-3.1502	1.6369	

Standard Error of Estimate = .7900

Coefficient of Determination $(\bar{R}^2)^a$ = .2006

Overall F-Ratio $(\frac{MSR}{MSE})$ = 2.6936*

[a]Adjusted for Degrees of Freedom

*Significant at .05

may be compared to Table 9, p. 99, in VDS Monograph Number 2.

In order to determine which student characteristic variables most efficiently predicted GPA (10th Grade), a restricted model was calculated. This was accomplished by utilizing a step-down technique as explained in Chapter 3. Table 6 shows the results of this technique. The overall F-ratio for the restricted model was found to be equal to 16.4057 which is highly significant beyond the .05 level. The multiple correlation was recomputed as .49.

The unadjusted coefficient of determination equaled .24 with an adjusted coefficient of determination value of .22. The restricted model will now explain 22 percent of the variability of GPA (10th Grade). It should be pointed out that the increases in both the F-ratio and the adjusted coefficient of determination and the decreases in both the multiple correlation and the unadjusted coefficient of determination were due to the elimination of variables which were providing only a small amount of useful information and an abundance of error variation.

Two student characteristic variables, GATB-N and Vocational Maturity, were found to be significant in the restricted model. These two student characteristic variables alone will predict approximately as much variability in GPA (10th Grade) as all sixteen student characteristic variables taken together. The partial regression coefficient obtained for GATB-N equaled .0521, thus, a one point increase on the GATB-N would predict a corresponding .0521 point increase in GPA (10th Grade) with the effect of Vocational Maturity held constant. The partial correlation coefficient for Vocational Maturity was .0267; likewise, a one point increase in Vocational Maturity would yield a .0267 increase in GPA (10th Grade) with the effect of GATB-N held constant.

Table 6. Regression Analysis Between the Two Student Characteristic Variables in the Restricted Model and the Dependent Variable GPA - 10th Grade

(N = 109)

Variables No.	Name	Partial Regression Coefficient	Standard Error	Student "t"
2.	GATB--N	.0521	.0171	3.0418*
13.	Vocational Maturity	.0267	.0071	3.7607*
Intercept		-1.4198	.7512	

Standard Error of Estimate = .7794

Coefficient of Determination $(\bar{R}^2)^a$ = .2220

Overall F-Ratio $(\frac{MSR}{MSE})$ = 16.4057*

[a]Adjusted for Degrees of Freedom

*Significant at .05

Table 6 can be compared to Table 10, p. 100, of VDS Monograph Number 2. The differences that occur between the findings of the two studies can be explained by recalling that the sample used in this study was a subsample of the one used by Kapes.

Question #3

Which combination of ninth grade student characteristics most efficiently predict school success as measured by tenth year shop grades?

Question 3 is similar to question 2 except Shop Grade (10th Grade) is used rather than GPA (10th Grade), therefore, the same statistical techniques will be used. Table 3 reveals that three student characteristic variables, GATB-V, GATB-S and Vocational Maturity correlate significantly with Shop Grade (10th Grade). It is also interesting to note from Table 2 that these three variables have a significant correlation with each other. The thirteen remaining student characteristics failed to correlate significantly with Shop Grade (10th Grade).

The outcome of the full model regression analysis with Shop Grade (10th Grade) as the criterion is shown in Table 7. An overall F-ratio of 2.472 was obtained and is significant. A multiple correlation of .53 was also obtained. The unadjusted coefficient of determination equals .28.

After adjusting the degrees of freedom of the coefficient of determination, it was recomputed as .1560. Using all sixteen student characteristic variables, approximately 16 percent of the variability of Shop Grade (10th Grade) can be explained. Three of the sixteen student characteristic variables were found to predict a significant

Table 7. Regression Analysis Between Sixteen Student Characteristic Variables in the Full Model and the Dependent Variable Shop Grade - 10th Grade

(N = 109)

Variables No.	Name	Partial Regression Coefficient	Standard Error	Student "t"
1.	GATB--V	.0039	.0162	2.0855*
2.	GATB--N	.0218	.0133	1.6385
3.	GATB--S	.0104	.0090	1.1587
4.	GATB--P	-.0105	.0087	1.2085
5.	GATB--Q	-.0301	.0132	2.2709*
6.	GATB--K	-.0086	.0118	.7281
7.	GATB--F	-.0025	.0079	.3179
8.	GATB--M	.0207	.0086	2.4156*
9.	Interest and Satisfaction	-.0037	.0350	.1045
10.	Salary	.0127	.0243	.5226
11.	Prestige	.0304	.0311	.9782
12.	Security	.0246	.0256	.9599
13.	Vocational Maturity	.0461	.0344	1.3400
14.	Father's Education	.0142	.1217	.1166
15.	Father's Occupation	.1218	.1540	.7904
16.	Occupational Aspiration	-.1985	.1314	1.5109
Intercept		-2.3145	2.4076	

Standard Error of Estimate = 1.1620

Coefficient of Determination $(\bar{R}^2)^a$ = .1560

Overall F-Ratio $(\frac{MSR}{MSE})$ = 2.2472*

[a]Adjusted for Degrees of Freedom

*Significant at .05

portion of the criterion variability, GATB-V, GATB-Q and GATB-M.

To eliminate duplicate and useless information thus making the model as efficient as possible, a step-down technique was again employed. The results of the regression analysis on the restricted model is shown in Table 8. The restricted model yielded an F-ratio of 5.8460 which is again significant beyond the .05 level. The multiple correlation was determined to be .47 with a corresponding unadjusted coefficient of determination of .22. The adjusted coefficient of determination was computed as .1832.

Five variables were found to provide information which was both unique and significantly useful in predicting Shop Grade (10th Grade) in the restricted model. They were GATB-V, GATB-N, GATB-Q, GATB-K and GATB-M. Of these five, two provide negative input and three provide positive input. This is evident from the partial regression coefficient as seen in Table 8.

GATB-V, GATB-N and GATB-M provide positive input with partial regression coefficients of .0402, .0296 and .0212 respectively. Thus, an increase in terms of any of these three variables will create an increase in the criterion, Shop Grade (10th Grade).

GATB-Q and GATB-K provide negative input with partial regression coefficients of -.0364 and -.0213. Since this is the first time a negative partial regression coefficient has been encountered in this study, a short explanation will be offered. Since the partial regression coefficient is negative, a one point increase in terms of GATB-Q will reflect a .0364 decrease in Shop Grade (10th Grade). The same would be true of GATB-K except the decrease would be .0213 in terms of Shop Grade (10th Grade).

Table 8. Regression Analysis Between the Five Student Characteristic Variables in the Restricted Model and the Dependent Variable Shop Grade - 10th Grade

(N = 109)

Variables No.	Name	Partial Regression Coefficient	Standard Error	Student "t"
1.	GATB--V	.0402	.0138	2.9091*
2.	GATB--N	.0296	.0119	2.4800*
5.	GATB--Q	-.0364	.0115	3.1549*
6.	GATB--K	-.0213	.0101	2.1126*
8.	GATB--M	.0212	.0071	2.9782*
Intercept		.1711	1.3725	

Standard Error of Estimate = 1.1431

Coefficient of Determination $(\bar{R}^2)^a$ = .1832

Overall F-Ratio $(\frac{MSR}{MSE})$ = 5.8460*

[a]Adjusted for Degrees of Freedom

*Significant at .05

The combination of five student characteristic variables in the restricted model explained 18 percent of the variability of Shop Grade (10th Grade). The restricted model again explains approximately the same amount of variability as the full model while at the same time being more efficient.

Question #4

Which combination of ninth grade student characteristics most efficiently predict school success as measured by eleventh year GPA?

Question 4 is identical to question 2 with the exception that the criterion is GPA (11th Grade) rather than GPA (10th Grade). As such, it was handled in a similar manner. From Table 3, GATB-V, GATB-N, GATB-S, GATB-Q, GATB-K, Interest and Satisfaction, and Vocational Maturity were found to correlate significantly and positively with the criterion. Salary and Prestige were found to correlate significantly and negatively with the criterion.

The results of the regression analysis of the full model are shown in Table 9. The overall F-ratio equaled 4.2713 and was found to be significant. The multiple correlation coefficient was computed as .66, with a corresponding unadjusted coefficient of determination of .44. After the degrees of freedom were adjusted, the adjusted coefficient of determination was determinated to be .33, with the full model, approximately one-third of the variability of GPA (11th Grade) can be explained.

Only two variables were found to be significant in the full model, GATB-V and Salary. These variables had partial regression coefficients of .0183 and -.0348 respectively.

Table 9. Regression Analysis Between Sixteen Student Characteristic Variables in the Full Model and the Dependent Variable GPA - 11th Grade

(N = 105)

Variables No.	Name	Partial Regression Coefficient	Standard Error	Student "t"
1.	GATB--V	.0183	.0085	2.1512*
2.	GATB--N	.0101	.0071	1.4082
3.	GATB--S	.0033	.0047	.7030
4.	GATB--P	-.0052	.0045	1.1475
5.	GATB--Q	.0131	.0072	1.8119
6.	GATB--K	.0036	.0061	.5897
7.	GATB--F	.0013	.0041	.3172
8.	GATB--M	-.0011	.0044	.2563
9.	Interest and Satisfaction	-.0055	.0182	.3009
10.	Salary	-.0348	.0126	2.7592*
11.	Prestige	-.0249	.0162	1.5387
12.	Security	-.0173	.0136	1.2752
13.	Vocational Maturity	.0315	.0179	1.7530
14.	Father's Education	.0564	.0632	.8922
15.	Father's Occupation	.0231	.0802	.2884
16.	Occupational Aspiration	.0570	.0686	.8317
Intercept		-1.3627	1.3000	

Standard Error of Estimate = .5982

Coefficient of Determination $(\bar{R}^2)^a$ = .3348

Overall F-Ratio $(\frac{MSR}{MSE})$ = 4.2713*

[a]Adjusted for Degrees of Freedom

*Significant at .05

In order to improve the efficiency of the prediction model, a step-down technique was used and a restricted model computed. The results of this process are shown in Table 10. The overall F-ratio which was obtained for the restricted model was 14.9580. This value is significant beyond the .05 level. A multiple correlation of .61 was found. The unadjusted coefficient of determination was discovered to be .37. The adjusted coefficient of determination became .3493. The restricted model explains about 35 percent of the variability in GPA (11th Grade).

Four variables were retained to make up the restricted model. These were GATB-V, GATB-N, Salary and Vocational Maturity. Three of these GATB-V, GATB-N and Vocational Maturity had positive partial regression coefficients of .0206, .0149 and .0382 respectively. Salary was again a negatively related variable with a partial regression coefficient of -.0305. This would indicate that increases in GATB-V, GATB-N and Vocational Maturity would predict an increase in GPA (11th Grade). Conversely, an increase in the value of Salary is associated with a decrease in GPA (11th Grade). These generalizations are true only when each of the other variables in the model are held constant.

Question #5

Which combination of ninth grade student characteristics most efficiently predict school success as measured by eleventh year shop grades?

This question is the same as question 3 with the exception that Shop Grade (11th Grade) is the criterion. The same statistical procedures will be used. A review of Table 3 reveals seven student characteristic variables; GATB-V, GATB-N, GATB-Q, Interest and Satisfaction, Salary,

Table 10. Regression Analysis Between the Four Student Characteristic Variables in the Restricted Model and the Dependent Variable GPA - 11th Grade

(N = 105)

Variables No.	Name	Partial Regression Coefficient	Standard Error	Student "t"
1.	GATB--V	.0206	.0077	2.6768*
2.	GATB--N	.0149	.0058	2.5667*
10.	Salary	-.0305	.0091	3.3421*
13.	Vocational Maturity	.0382	.0143	2.6748*
Intercept		-.9427	.7373	

Standard Error of Estimate = .5916

Coefficient of Determination $(\bar{R}^2)^a$ = .3493

Overall F-Ratio $(\frac{MSR}{MSE})$ = 14.9580*

[a]Adjusted for Degrees of Freedom

*Significant at .05

Prestige and Vocational Maturity correlate significantly with Shop Grade (11th Grade). Of the seven, five correlate positively while two, Salary and Prestige, correlate negatively.

The results of the full model analysis are shown in Table 11. A significant overall F-ratio was obtained with a value of 3.4671. The value of the multiple correlation coefficient was determined to be .62. The unadjusted coefficient of determination was equal to .39. Computation of the adjusted coefficient of determination yielded a value of .2751. Thus, the full model provides information which will explain 25 percent of the variability of Shop Grade (11th Grade). Two student characteristic variables were found to be significant predictors in the full model. They were Salary and Vocational Maturity.

Upon completion of the step-down process, a restricted model was developed which had an overall F-ratio value of 17.5402 as shown in Table 12. This value was found to be highly significant. The multiple correlation coefficient for the restricted model turned out to be .59 with a corresponding unadjusted coefficient of determination of .34. In order to allow for shrinkage that might occur upon cross-validation, the adjusted coefficient of determination was computed with a resulting value of .3230. Thus, about 32 percent of the variability of Shop Grade (11th Grade) can be predicted by utilizing the restricted model.

Three student characteristic variables were found to possess enough useful and unique information to remain in the restricted model. They were GATB-V, Salary and Vocational Maturity. The respective partial regression coefficients were found to be .0237, -.0343 and .0671. Salary is again negatively related to the criterion and an increase in value of Salary is related to a decrease in the Shop Grade (11th Grade). GATB-V

Table 11. Regression Analysis Between the Sixteen Student Characteristic Variables in the Full Model and the Dependent Variable Shop Grade - 11th Grade

(N = 105)

Variables No.	Name	Partial Regression Coefficient	Standard Error	Student "t"
1.	GATB--V	.0182	.0105	1.7306
2.	GATB--N	.0070	.0088	.7977
3.	GATB--S	.0011	.0058	.1939
4.	GATB--P	-.0039	.0056	.7067
5.	GATB--Q	.0087	.0089	.9778
6.	GATB--K	.0038	.0075	.5004
7.	GATB--F	-.0046	.0050	.9154
8.	GATB--M	.0028	.0054	.5126
9.	Interest and Satisfaction	-.0129	.0225	.5751
10.	Salary	-.0421	.0156	2.7016*
11.	Prestige	-.0242	.0200	1.2102
12.	Security	-.0167	.0168	.9980
13.	Vocational Maturity	.0587	.0221	2.6539*
14.	Father's Education	.0171	.0780	.2186
15.	Father's Occupation	-.0101	.0990	.1020
16.	Occupational Aspiration	.0230	.0846	.2714
Intercept		-.3339	1.6038	

Standard Error of Estimate = .7380

Coefficient of Determination $(\bar{R}^2)^a$ = .2751

Overall F-Ratio $(\frac{MSR}{MSE})$ = 3.4671*

[a]Adjusted for Degrees of Freedom

*Significant at .05

Table 12. Regression Analysis Between the Three Student Characteristic Variables in the Restricted Model and the Dependent Variable Shop Grade - 11th Grade

(N = 105)

Variables No.	Name	Partial Regression Coefficient	Standard Error	Student "t"
1.	GATB--V	.0237	.0090	2.6439*
10.	Salary	-.0343	.0110	3.1115*
13.	Vocational Maturity	.0671	.0171	3.9312*
Intercept		-.4501	.8136	

Standard Error of Estimate = .7132

Coefficient of Determination $(\bar{R}^2)^a$ = .3230

Overall F-Ratio $(\frac{MSR}{MSE})$ = 17.5402*

[a]Adjusted for Degrees of Freedom

*Significant at .05

and Vocational Maturity were positively related to the criterion and, therefore, an increase in either of these two variables will result in an increase in the criterion. These findings may be compared with those in VDS Monograph Number 4, Table 8, p. 48.

Question #6

Which combination of ninth grade student characteristic variables most efficiently predict school success as measured by eleventh year OTAT scores?

In an effort to develop an intuitive feeling for what might occur in the regression analysis techniques, reference was made to Table 3. It was found that five student characteristic variables were significantly related to OTAT score, GATB-V, GATB-S, Interest and Satisfaction, and Vocational Maturity were positively related to the criterion. Prestige was negatively related to the criterion.

The analysis of the full model, as shown by Table 13, resulted in an overall F-ratio of 1.8664 which is significant at the .05 level. The multiple correlation coefficient was equal to .50. The obtained unadjusted coefficient of determination was .25. The corresponding adjusted coefficient of determination was found to be .1138. This means 11 percent of the variability of OTAT can be predicted by the full model. Two student characteristic variables were found to be significantly predictive in the full model. They were GATB-V and GATB-P. These results can be reviewed in light of those outlined in Table 6, p. 44 of VDS Monograph Number 4.

As in previous instances, a step-down technique was undertaken with a resultant restricted model (see Table 14). The overall F-ratio for the

Table 13. Regression Analysis Between the Sixteen Student Characteristic Variables in the Full Model and the Dependent Variable OTAT

(N = 109)

Variables No.	Name	Partial Regression Coefficient	Standard Error	Student "t"
1.	GATB--V	2.6165	1.2530	2.0881*
2.	GATB--N	-.0405	1.0281	.0394
3.	GATB--S	.8987	.6930	1.2968
4.	GATB--P	-1.5546	.6675	2.3990*
5.	GATB--Q	1.0279	1.0221	1.0057
6.	GATB--K	.2040	.9086	.2245
7.	GATB--F	.1420	.6068	.2340
8.	GATB--M	.3404	.6610	.5149
9.	Interest and Satisfaction	.9381	2.7030	.3470
10.	Salary	.0561	1.8720	.0300
11.	Prestige	.3067	2.3971	.1279
12.	Security	1.2108	1.9792	.6118
13.	Vocational Maturity	4.8296	2.6551	1.8910
14.	Father's Education	-5.0349	9.3947	.5359
15.	Father's Occupation	1.0007	11.8867	.0842
16.	Occupational Aspiration	-.2378	10.1379	.0235
Intercept		-23.5895	185.7827	

Standard Error of Estimate = 89.6655

Coefficient of Determination $(\bar{R}^2)^a$ = .1138

Overall F-Ratio $(\frac{MSR}{MSE})$ = 1.8664*

[a]Adjusted for Degrees of Freedom

*Significant at .05

Table 14. Regression Analysis Between the Three Student Characteristic Variables in the Restricted Model and the Dependent Variable OTAT

(N = 109)

Variables No.	Name	Partial Regression Coefficient	Standard Error	Student "t"
1.	GATB--V	4.0128	.9863	4.0687*
3.	GATB--S	1.3044	.5845	2.2317*
4.	GATB--P	-1.0376	.4908	2.1142*
Intercept		107.4574	96.5495	

Standard Error of Estimate = 86.7681

Coefficient of Determination $(\bar{R}^2)^a$ = .1701

Overall F-Ratio $(\frac{MSR}{MSE})$ = 8.3788*

[a]Adjusted for Degrees of Freedom

*Significant at .05

restricted model was 8.3788 and is significant at the .05 level. The value of the multiple correlation coefficient was .43. The unadjusted coefficient of determination was defined as .19. The adjusted coefficient of determination was computed to be .1701. Therefore, 17 percent of the variability of OTAT scores can be explained using this restricted model.

Three student characteristic variables were found to compose the restricted model, GATB-V, GATB-S and GATB-P. The first two, GATB-V and GATB-S, had positive partial regression coefficients of 4.0128 and 1.3044 respectively. GATB-P had a negative partial regression coefficient calculated to be -1.0376. Again, an increase in GATB-V or GATB-S will indicate an increase in OTAT total raw score, with GATB-P being held constant and an increase in GATB-P will precipitate a decrease in OTAT raw score under like conditions. It may be of interest to the reader to compare these findings with those of Enderlein (1972) as outlined in Table 7 of VDS Monograph Number 4, p. 45. It should, however, be remembered when comparing these results with those of Enderlein, that differences will occur because of differences in sample size and the parent populations from which the samples were drawn.

V

SUMMARY, CONCLUSIONS AND DISCUSSION

This chapter will provide a summary of this study, conclusions based on the findings, and a discussion of the practical meaning of the findings and conclusions.

Summary

Introduction

Education to teach skills necessary to provide a living for one's family (vocational education) has existed since the beginning of time. While this educational process was once of a very informal and general nature, today it has taken on a more formal and specialized aspect. That is, it has changed from the teaching of many skills necessary to provide food, shelter and clothing to the teaching of specific skills which will provide the income with which to purchase these necessities. We have come to live in a world of specialization where, with few exceptions, the butcher has his car repaired by a mechanic; the mechanic has his house wired by an electrician and the electrician buys meat from the butcher.

Likewise, the indicators of success have become more subtle and complicated. Survival of the family unit was once the only criterion of success. Today, at least in this society, most family members will survive. But mere survival is no longer the criterion. Success is measured in many ways. Many things are used as indicators of success such as annual income, amount of formal education, productivity, employers' ratings, membership in organizations, position in the community, self ratings and many others.

With the complications in measuring success in life have come complications in measuring educational success. Educational success can be separated into overall educational success and success in specific areas. This success can be measured by either objective or subjective means. One of the basic premises of our educational system is that this in-school success is related to out-of-school success. Likewise, success in specific areas of education should be related to success in the overall educational process.

In an effort to measure different types of in-school success, many different systems have developed. Different philosophies have spawned different systems with different measures. However, three measures that are widely used are grade point average (GPA), specific course grades, and standardized instruments. GPA has been commonly used to measure overall educational success, while course grades and standardized instruments have measured success in specific educational areas.

Statement of the Problem

This study was in part a replication of studies by Kapes (1971) and Enderlein (1972) which were published as VDS Monograph Numbers 2 and 4 respectively. It was a replication in the sense that many of the same variables were used. However, it was an extension of those studies in that three different measures of success collected at five points in time were used in this study. This made it possible to examine the relationship among the various success measures as well as determine which student characteristics were useful in predicting each. Thus, this study examined the validity of the various criteria of in-school success and attempted to support the success model discussed and presented in Chapter 1.

Specifically, this study attempted to answer the following questions:

1. What is the relationship among the five measures of school success?
2. Which combination of ninth grade student characteristics most efficiently predict school success as measured by tenth year GPA?
3. Which combination of ninth grade student characteristics most efficiently predict school success as measured by tenth year shop grades?
4. Which combination of ninth grade student characteristics most efficiently predict school success as measured by eleventh year GPA?
5. Which combination of ninth grade student characteristics most efficiently predict school success as measured by eleventh year shop grades?
6. Which combination of ninth grade student characteristics most efficiently predict school success as measured by eleventh year OTAT scores?

Procedure

The sample utilized in this study consisted of 109 vocational students for the tenth grade phase and 105 of the same students for the eleventh grade phase. To be included in the sample, a student had to be attending the Altoona Pennsylvania Area Vocational-Technical School. In addition, the sample was limited to those shop areas for which the OTAT was available. These shop areas were: Auto Mechanics, Electricity, Electronics, Machine Shop, Drafting and Design, Printing, Sheet Metal, Welding, Auto Body,

Carpentry, and Cosmetology. If a student failed to complete the eleventh year, he was dropped from the study and four students fell into this category. This accounts for the difference in the sizes of the tenth and eleventh grade samples.

Ninth grade student characteristic data was gathered in the spring of 1969. Tenth and eleventh year GPA and shop grade were obtained at the end of the 1969-70 and 1970-71 school year respectively. The Ohio Trade and Industrial Education Achievement Test (OTAT) was administered in March 1971. All data used in this study were gathered as a part of a longitudinal study of vocational development being conducted by the Department of Vocational Education at The Pennsylvania State University in cooperation with the Pennsylvania Research Coordinating Unit.

Five dependent variables were used: GPA (10th Grade), Shop Grade (10th Grade), GPA (11th Grade), Shop Grade (11th Grade) and OTAT total raw score. Sixteen student characteristics were utilized as independent variables in this study. These were: the General Aptitude Test Battery (GATB) scales for Verbal, Numerical, Spatial, Form Perception, Clerical Perception, Motor Coordination, Finger Dexterity, and Manual Dexterity aptitudes; the Occupational Values Inventory (OVI) measures of Interest and Satisfaction, Salary, Prestige and Security; Vocational Maturity as measured by the Vocational Development Inventory (VDI); the socioeconomic indicators of Father's Education and Father's Occupational Level; and the level of the student's realistic Occupational Aspiration.

Two statistical methods were employed in the analysis of the data. Question 1 was answered by using the Pearson Product Moment Correlation. Analysis (PPMC). Questions 2 through 6 were answered using multiple regression analysis (MRA) with both full models and the restricted models

obtained by applying a step-down technique.

Findings

In an effort to provide a statistical beginning point, zero-order correlations among the sixteen student characteristic variables and between the student characteristic variables and the five measures of school success were computed. The range of the correlations among the independent variable was from -.53 to .57. Most of the intercorrelations were relatively small. The correlation between the independent variables and the criteria ranged from -.32 to .47. Two student characteristic variables, GATB-V and Vocational Maturity, were found to correlate significantly with each of the criteria at the .05 level. Seven of the student characteristic variables, GATB-P, GATB-F, GATB-M, Security, Father's Education, Father's Occupation, and Occupational Aspirations, did not correlate significantly with any of the five school success measures.

With the notable exception of shop grade (10th Grade), the correlations among the criteria were all significant and ranged from .29 to .84. Shop Grade (10th Grade) did not correlate significantly with any of the other criteria except GPA (10th Grade).

With GPA (10th Grade) as the dependent variable, the regression analysis of the full model yielded an overall F-ratio of 2.6936 which is significant at the .05 level. The multiple correlation coefficient (R) was found to be .55 and the adjusted coefficient of determination ($\bar{R}^2$) was equal to .20. After completing the step-down process, the overall F-ratio was computed as 16.4057 which is significant beyond the .05 level. The value of $\bar{R}^2$ for the restricted model was .22. GATB-N and Vocational Maturity were the two student characteristic variables with enough sig-

nificant and unique information to remain in the restricted model.

Using MRA to investigate the criterion shop grade (10th Grade), the full model produced a significant overall F-ratio of 2.2472. The value of .53 was calculated for the multiple R with a corresponding $\bar{R}^2$ value of .16. In the restricted model, an overall F-ratio of 5.8460 was obtained and found to be significant. Computation of $\bar{R}^2$ for the restricted model yielded a value of .18. Five student characteristics were found to compose the restricted model. They were: GATB-V, GATB-N, GATB-Q, GATB-K, and GATB-M.

The third MRA utilized GPA (11th Grade) as the dependent variable. A significant overall F-ratio of 4.2713 was found for the full model. The multiple R value was determined to be .66 with a corresponding value of .33 for $\bar{R}^2$. The restricted model yielded an overall F-ratio of 14.9580 and an $\bar{R}^2$ value of .35. Four independent variables, GATB-V, GATB-N, Salary, and Vocational Maturity, were used to construct the restricted model.

When shop grade (11th Grade) became the success measure used as the criterion, the full model was found to be significant at the .05 level with an overall F-ratio of 3.4671. The multiple R for the full model was computed as .62. The value obtained for $\bar{R}^2$ was .28. After completion of the step-down process, the restricted model overall F-ratio was 17.5402. $\bar{R}^2$ was recalculated to be .32. GATB-V, Salary, and Vocational Maturity were found to be significant and unique predictors of shop grade (11th Grade).

The final MRA was run with OTAT score as the dependent variable. An overall F-ratio of 1.8664 was obtained and found to be significant at the .05 level. A multiple R of .50 resulted with a corresponding value for

$\bar{R}^2$ of .11. The restricted model yielded an overall F-ratio of 8.3788 and a multiple R of .43. The value of $\bar{R}^2$ for the restricted model was found to be .17. Three student characteristic variables were combined to make up the restricted model: GATB-V, GATB-S, and GATB-P.

Conclusions

This section will be held to brief statements of conclusions with respect to each criterion. To facilitate this discussion, the results of the five restricted models presented in Chapter 4 have been condensed and are shown in Table 15.

Question #1

1. A significant relationship exists among the various success measures. The notable exception is Shop Grade (10th Grade).
2. The closer the relationship of the success measures in terms of time, the greater the relationship.
3. The relationship among the success measures tends to support the model, proposed in Chapter 1, dealing with the relationship among the in-school success measures.
4. Existing literature lends at least some support to the assumption presented in the model that in-school success is related to out-of-school success.

Question #2

1. Of the five criteria used in this study, GPA (10th Grade) was the third most predictable by the student characteristic variables utilized in this study.

Table 15. Comparison of the Student Characteristic Variables Composing the Restricted Models for all Five Criterion Variables

Variables No.	Name	GPA (10th Grade)	Shop Grade (10th Grade)	GPA (11th Grade)	Shop Grade (11th Grade)	OTAT
1.	GATB-V		X	X	X	X
2.	GATB-N	X	X	X		
3.	GATB-S					X
4.	GATB-P					X
5.	GATB-Q		X			
6.	GATB-K		X			
8.	GATB-M		X			
10.	Salary			X	X	
13.	Vocational Maturity	X		X	X	
	$\bar{R}^2$	.22	.18	.35	.32	.17

2. An increase in GPA (10th Grade) is reflected by an increase in numerical aptitude and vocational maturity with 22 percent of the variability explained by these two student characteristics.

Question #3

1. Shop Grade (10th Grade) was the fourth most predictable of the five success measures investigated in the study in terms of the student characteristics used.
2. Increases in verbal aptitude, numerical aptitude, and manual dexterity as well as decreases in clerical perception and motor coordination are associated with an increase in Shop Grade (10th Grade). These five characteristic variables taken together will explain 18 percent of the variability in Shop Grade (10th Grade).

Question #4

1. GPA (11th Grade) was the most predictable of the criteria examined by this study in terms of the student characteristics used.
2. GPA (11th Grade) increases as verbal aptitude, numerical aptitude and vocational maturity increase and as value of salary decreases. These four variables account for 35 percent of the variability of the criterion.

Question #5

1. The second most predictable of the success measures investigated was Shop Grade (11th Grade) as predicted by the student characteristic variables utilized.

2. Increases in verbal aptitude and vocational maturity and a decrease in value of salary are accompanied by an increase in Shop Grade (11th Grade). Using these three student characteristic variables, 32 percent of the variability of Shop Grade (11th Grade) can be explained.

Question #6

1. OTAT was the least predictive of the five success measures used in this study in terms of the student characteristics utilized.
2. OTAT increases as verbal aptitude and spatial aptitude increase and as form perception decreases. Using only these three variabilities, 17 percent of the criterion is explainable.

Discussion

One of the most important findings of this study dealt with the relationship between the predictor variables and the criterion in terms of time. Remembering that the student characteristic variables used in this study were obtained during the ninth grade, it is interesting to examine the relationship between the predictor variables and the various criterion. Since both GPA and Shop Grade were obtained at two points in time (end of tenth and eleventh grades), a comparison of the predictiveness of the same criterion at two points in time is possible. By examining Table 15, it can be seen that the predictiveness of GPA increased approximately 13 percentage points (of explained variance) from tenth to eleventh year. Shop Grade shows similar results with a 14 percentage point increase from tenth to eleventh year. Thus, the pre-

dictive power of the ninth grade student characteristic variables increases with time. That is to say, the ninth grade student characteristic predict the eleventh grade criteria better than they predict the same criteria obtained in tenth grade. Although no statistical explanation was available from the results of this study which would explain this increase in predictiveness over time, the presence of vocational maturity and salary in the predictor models may provide some insight. As time goes on, those who were more vocationally mature in ninth grade and valued salary less become more compatible with the training environment. In contrast to the relationship between predictors and criteria, the relationship among the criteria increases as the time interval between them decreases.

GPA (10th Grade) was most efficiently predicted by numerical aptitude and vocational maturity. The presence of numerical aptitude in the prediction model may indicate that one of the most important school subjects in differentiating between various student's tenth grade GPA is their success in the math course taken in tenth grade. Since vocational maturity was also a significant variable in the prediction of the criterion, perhaps those students who are able to visualize and reconcile the importance of educational activities outside their specific trade area will be more successful in terms of the overall educational experience. This coincides with the finding of Finger (1966) that motivation is related to educational success.

Five student characteristics: verbal aptitude, numerical aptitude, clerical perception, motor coordination, and manual dexterity, were the best predictors of Shop Grade (10th Grade). As would be expected because of the manipulative nature of the instruction in vocational shops, those

students with a higher degree of manual dexterity tended to have higher achievement. The presence of verbal and numerical aptitudes in the prediction model indicate these skills are necessary to master the technical material required for success. At first glance, it is surprising that clerical perception and motor coordination are negatively related to the criterion. After some thought, this relationship begins to make intuitive sense. Assuming that much of the tenth grade shop experience is devoted to repetition aimed at teaching the basic skills, those students with prior experience or who are good at clerical and motor tasks may tend to become bored and receive lower grades because of the attitude they exhibit. This is supported by the conclusion reached by Kapes and Long (1971) that instructors base grades on many things other than just acquisition of knowledge and skills.

Verbal aptitude, numerical aptitude, and vocational maturity were found to be positively related to GPA (11th Grade). Value of salary was found to be negatively related to the criterion. The same basic reasoning would still hold, as with GPA (10th Grade), for the usefulness of numerical aptitude and vocational maturity in the prediction of GPA (11th Grade). The addition of verbal aptitude adds a dimension which indicates that the student's reading ability becomes more important as he advances in the educational system. On the surface, the negative relationship between value of salary and the criterion does not seem logical. If, however, we logically connect value of salary to vocational maturity by saying those whose value of salary is high, probably are interested in leaving school and obtaining employment; the negative relationship begins to have meaning.

Unlike Shop Grade (10th Grade), Shop Grade (11th Grade) was not found to be predicted by any manipulative abilities. The significant variables were verbal aptitude, value of salary, and vocational maturity. The eleventh grade shop curriculum appears to emphasize the cognitive skills and technical knowledge of the trade area and this is reflected by the predictiveness of verbal aptitude. Value of salary was again negatively related to the criterion while vocational maturity was positively related. The possible explanations for this is the same as that offered above.

Verbal aptitude, spatial aptitude and form perception were found to be the best predictors of OTAT total raw score. Since the OTAT is a pencil and paper test, verbal aptitude (reading ability) would play an important role in achievement on the OTAT. The ability to comprehend two dimensional representations of three dimensional objects (spatial aptitude) is predictive of OTAT total raw score because these types of problems are included in the test. The negative relationship between form perception and OTAT is difficult to understand and no simple explanation is apparent to this researcher. These findings are supported by Finch and Bjorkquist (1970), Kapes and Long (1971) and Enderlein (1972) in that the OTAT was concluded to be useful in measuring the general knowledge and cognitive skills taught in a vocational program. Enderlein (1972) concluded for eleventh graders that verbal aptitude was the only significant factor in predicting OTAT total raw score. The significance of two additional student characteristic variables in this study may be explained by the differences in sample make-up and size.

The importance of verbal and numerical abilities in the achievement of success in the educational system cannot be overemphasized. This has

been an assumption held by educators and guidance counselors for many years. Both this study and Kapes (1971) serve to re-emphasize this fact. These abilities are important in the vocational curriculum, but not to the exclusion of other characteristics such as occupational values and vocational maturity.

It was stated in Chapter 1 that socioeconomic background measures could be expected to be significant in predicting both tenth and eleventh year GPA. This was not an outcome of this study. By referring to Kapes (1971), this outcome can be explained. Kapes found background measures (father's education) to be a significant predictor of the student's curriculum choice (academic vs. vocational) and a significant predictor of GPA for only those student's enrolled in the academic curriculum. Thus, the effect of the socioeconomic background on school success is apparently decreased within the vocational curriculum.

As has been previously stated, grades are subjective measures and include conscious and unconscious assessments of many things other than just abilities and knowledge as assessed by the instructor. Even allowing for this unidentified input to grades, the success measures investigated in the study seem to be relatively good measures of various aspects of in-school success, and they also seem to fit together as proposed by the model in Chapter 1. Because of the strong relationship among the success measures, with the exception of Shop Grade (10th Grade), the choice of a criterion to be used in measuring a student's in-school success is not as critical as had they been totally unrelated. However, since the obtained relationship is not perfect (i.e. $r = 1.0$), it appears that GPA is the best measure of overall educational success; Shop Grade, the best measures of success in the vocational program; and OTAT, the

best measure of success in mastering knowledges and cognitive skills pertinent to a particular vocational shop.

At least two further studies are needed to make the model proposed by this study highly generalizable. The first is a replication of this study using a sample of students enrolled in the academic curriculum. OTAT total raw score would not be applicable to academic students, but other instruments such as those commonly used as entrance examinations by colleges and universities might be substituted.

The second study is more extensive and complicated. A follow-up study to determine the relationship between in-school and out-of-school success should be undertaken utilizing these same sixteen student characteristic variables. It is suggested that a criteria more universally acceptable than income be developed and used to measure success after graduation from formal schooling. This would require the inclusion of many types of data, both objective and subjective, in order to determine the degree of success an individual had attained in his eyes, in the eyes of his peers, and as measured by society's yardstick. Such a criterion would be difficult to develop, to say the least. However, if a more valid assessment of the relationship between in-school and out-of-school success is to be obtained, a more valid criterion of out-of-school success must be developed. Even if you measure as accurately as possible, if you use the wrong yardstick, you might as well have guessed and probably would have been no less accurate while saving a lot of time and energy.

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